(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
26 September 2002 (26.09.2002)

PCT

(10) International Publication Number
WO 02/075766 A1

(51) International Patent Classification[7]: H01J 17/18

(21) International Application Number: PCT/KR02/00244

(22) International Filing Date: 18 February 2002 (18.02.2002)

(25) Filing Language: Korean

(26) Publication Language: English

(30) Priority Data:
2001/14142 19 March 2001 (19.03.2001) KR

(71) Applicant and
(72) Inventor: PARK, Jae-Hong [KR/KR]; #25-705, Samsung apt., 175-1, Oryu-dong, Jung-gu, Taejon 301-829 (KR).

(74) Agents: YIM, Suk-Jae et al.; 8th Floor, Poonglim Bldg., 823-1, Yeoksam-dong, Kangnam-ku, Seoul 135-784 (KR).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.

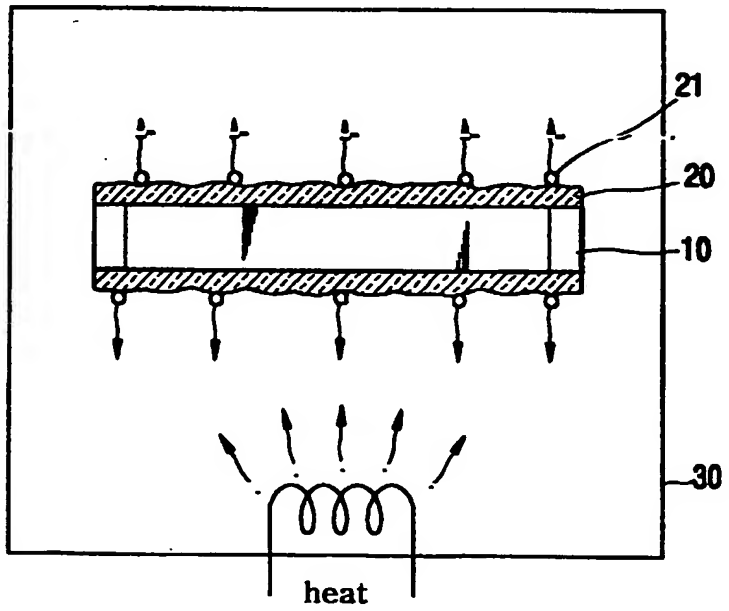
(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

WO 02/075766 A1

(54) Title: A SEAL GLASS WHICH IS ADHESIVE IN VACUUM, ITS MANUFACTURING METHOD, AND A FLAT PANEL DISPLAY DEVICE MANUFACTURED BY USING IT



(57) Abstract: The present invention relates to seal glass applied for sealing the glass elements such as FED(Field Emission Display), PDP(Plasma Display Panel), VFD(Vacuum Fluorescence Display), and Flat Light Source in vacuum, its manufacturing method and a flat panel display device manufactured by using it. The seal glass according to the present invention is manufactured by the steps of; applying frit glass in paste to the both surfaces of side glass formed in the predetermined shape in some thickness, drying it, heating it in the vacuum chamber. Herein, the heating step is for melting the frit and eliminating binder and gas.

A SEAL GLASS WHICH IS ADHESIVE IN VACUUM, ITS MANUFACTURING METHOD, AND A FLAT PANEL DISPLAY DEVICE MANUFACTURED BY USING IT

Technical Field

The present invention relates to a method for forming a flat panel display such as PDP, FED and VFD. More specifically, the present invention relates to a seal glass which can be used in sealing a flat panel display under a vacuum and a method for producing the seal glass. The invention also relates to a flat panel display which uses the seal glass.

Background of the invention

Generally, flat panel displays (FPD's), which include plasma display panel (PDP), field emission display (FED) and vacuum fluorescence display (VFD), are produced by sealing two glasses under a vacuum using frit while maintaining hermetic sealing.

There are two methods for sealing a panel using frit in prior art. One method is sealing two glasses directly by depositing frit on one surface of back plate, which is one of the two glasses to be sealed, with predetermined width and thickness. The other method is using a seal glass made from a side glass prepared in a predetermined form to adjust the gap between glasses.

The seal glass is produced by depositing frit with predetermined thickness on both sides of a side glass which is prepared in a predetermined form by using the method of dispensing or screen printing. The glass is then dried and undergoes glazing process at the temperature of 300℃ or more. This glazing process is performed under atmospheric pressure with oxygen present in order to remove binder in the frit through oxidation. In this way, a seal glass which can be used in sealing process is made.

In direct sealing method, frit paste is directly deposited on the predetermined region of display panel, and drying and glazing process are performed as above.

The seal glass made by conventional methods or frit formed on the panel has disadvantage that because of the bubble and gas which are generated from the frit during sealing process under a vacuum, the sealing characteristics and strength are deteriorated. This problem originates from the glazing process which is carried out under atmosphere and so cannot remove binder and gas in the frit. In other words, when sealing temperature of sealing process is raised over some temperature, bubbles are generated deteriorating the characteristics of the panel sealing. On the other hand, when the temperature is lowered to prevent the generation of bubble, the sealing becomes inferior.

Moreover, in the prior art method for sealing two panels, a ventilation tube is used to ventilate the panel to the desired vacuum. The ventilation tube is formed in advance on the predetermined region of one side of the panel and is sealed after ventilation by heating the tube. The sealing characteristics become bad since bubbles are generated when sealing is performed under a vacuum by using the seal glass. Therefore, vacuum is generated by using the ventilation tube after sealing is completed.

However, since the ventilation tube remains projected, the panel is very inconvenient to process and the possibility of breaking increases. Moreover, the time of the ventilation process is about 10 hours and so automated process requires a ventilation line of about tens of meters (for example, 50m) in order to perform the ventilation process for 10 hours. Therefore, the cost of equipment is raised while the productivity is lowered.

Summary of the Invention

One object of the present invention is to provide a method of producing a seal glass for sealing glasses under a vacuum.

Another object of the present invention is to provide a seal glass from which binder and gas are removed and which can be used in sealing under a vacuum. This seal glass can be produced in advance and provided as a separate commercial product.

Another object of the present invention is to provide a flat panel display produced by using the above seal glass without ventilation tube.

To achieve these objects, in the method for producing the seal glass according to the present invention, the glazing process of frit glass is performed under a vacuum without air in order to prevent the generation of bubble or gas during sealing process. The frit glass is in the form of powder or paste of frit glass whose coefficient of heat expansion is identical with the glass to be sealed.

To produce the seal glass of the present invention, the frit is heated under a vacuum in order to remove binder and gas in the frit and molded to the predetermined shape in the fluid state, and is produced in the form of a seal glass.

Another form of the seal glass of the present invention is provided by the process comprising the steps of depositing frit on both sides of a side glass, heating the glass under a vacuum to remove binder and gas, and finally producing a seal glass with frit deposited and sintered.

In addition, by using the seal glass of the present invention in directly sealing the upper and lower panels of the flat panel display, a flat panel display without a ventilation tube can be provided since ventilation process is not required.

Brief Description of Drawings

Figs. 1A to 1C illustrate the production process of the seal glass of the present invention which can be used in sealing under a vacuum.

Figs. 2A to 2C illustrate the side glass of the present invention.

Fig. 3A illustrates another embodiment of producing a seal glass of the present invention.

Fig. 3B illustrates another embodiment of producing a seal glass of the present invention, which uses mold.

Figs. 4A to 4C illustrate the process of producing flat panel display without ventilation tube according to the present invention.

<Description of the symbol of the main part of the drawing>

10 : side glass	20 : frit
21: binder and gas	30 : vacuum chamber
40: melting pot and jig	50 : nozzle
60 : molding mold	100 : seal glass
100' : frit bar	200 : flat panel display
210, 220 : panel	230 : ventilation opening

Best Mode for Carrying out the Invention

Now a seal glass of the present invention and a method for producing the seal glass will be described in detail with references to accompanying drawings.

The method for producing a seal glass according to one embodiment of the present invention, as shown in Figs. 1A to 1C, comprises step 1 (Fig. 1A) which deposits frit 20 in the form of powder or paste on both sides of a side glass 10 and dries the side glass; step 2 (Fig. 1B) which applies heat to the dried side glass with frit 20 deposited thereon under a vacuum in a vacuum chamber 30 in order to remove binder and gas 21 in the frit; and step 3 (Fig. 1C) which produces a seal glass 100 by cooling the side glass from which binder and gas 21 are removed.

In other words, frit 20 in the form of paste is deposited on the surface of the side glass 10, which is prepared in a predetermined shape, with predetermined thickness by using the method of dispensing or screen printing, and the glass undergoes drying process. The side glass 20 with frit 10 deposited thereon is placed in the vacuum chamber 30 and heat is applied to melt the frit 20 and to remove binder and gas 21. In this way, a seal glass 100 which can be used in sealing under a vacuum is produced.

The seal glass 100 is produced according to sealing type and specification of the flat panel display by cutting the side glass 10, connecting in the form of a seal glass 100, depositing frit on both sides of the glass, heating in the vacuum chamber in order to remove binder and gas 21, and cooling the seal glass 100. In this way a seal glass which can be used in sealing under a vacuum is produced in advance and can be provided as a separate commercial product of sealing member.

The side glass 10, as shown in Figs. 2A to 2C, is prepared by cutting the glass in advance with predetermined form of the seal glass 100 (for example, the square flame of the Fig. 2A) according to the object to be sealed, and then frit is deposited on both sides of glass and dried. As an example, as shown in Fig. 2A, the glass can be cut in square frame or 'L' shape or bar shape. And then the side glass 10 is produced in advance by joining as square frame, and frit is deposited on both sides of side glass 10 with square frame shape.

As another example, as shown in Fig. 2B, the glass bar is cut with predetermined thickness and width according to the joining specification of the object to be sealed and frit is deposited on the both sides of the glass and dried. Then after aligning the glass bars according to the specification of the object to be sealed, the frit 20 is deposited on the joining area of the glass bar again and dried, and a side glass 10 is produced with predetermined shape.

Also, the seal glass for capping is shown in Fig. 2C, which is designed to block the ventilation opening. This seal glass is produced by depositing frit on one side of a side glass for

capping, which may be circular or rectangular plate of metal or glass, and drying and melting under a vacuum in order to remove binder and gas.

Since the seal glass 100 of the present invention which is molded after removing binder and gas 21 in frit 20, there is no generation of gas and bubble during sealing process of panel in the vacuum chamber 30.

Fig. 3A illustrates schematically another embodiment of the present invention. In this embodiment, the seal glass is produced without using a side glass by removing binder and gas through heating the frit of the form of powder or paste in the melting pot or jig, and by molding the frit while maintaining fluidity into a predetermined form. The frit is extruded through a nozzle 50 while maintaining fluidity in the form of frit cylinder or frit bar 100', and then molded in a mold 60 while maintaining fluidity.

The frit cylinder or frit bar 100' are aligned on the panel sealing line, and sealed by applying pressure and heat in a vacuum chamber. At this step, the frit cylinders or frit bars are aligned in the form of seal glass 100 overlapping at the corners. The sealing is carried out with uniform thickness since the frit is melted in the sealing process.

As described above, the seal glass of the present invention is classified as a seal glass which uses a side glass, a seal glass which does not use a side glass, and a seal glass for capping.

When using a side glass, the side glass can be made in the form of square frame with frit deposited and dried, and binder and gas are removed. Or, the side glass can be cut and aligned and after depositing frit on the joining region again, binder and gas are removed, and applied as a seal for FED or VFD

When the side glass is not used in molding, frit is heated in a melting pot or jig in a vacuum chamber to remove binder and gas, and molded in a predetermined shape while having fluidity. The frit can be extruded directly into a frit cylinder or can be molded using mold to apply to the frame seal of PDP.

Seal glass for capping is produced by depositing frit on one side of the metal and glass with predetermined shape and thickness, drying the frit, and melting to remove gas. This seal glass is applicable to capping process after PDP gas injection process, or to capping process after sealing FED, VFD (the capping process can be omitted depending on the process).

Figs. 4a and 4b illustrate the process of sealing a flat panel display by using the seal glass of the present invention. Seal process of the flat panel display is performed by using the seal glass of the present invention. First, the seal glass 100, which may be made from a side glass with frit deposited on both sides or may be produced using frit cylinder without side glass, is aligned on one side of panel 210. And, other panel 220 is aligned on the side of the panel where seal glass 100 is aligned, in a vacuum chamber 30. Then two panels are sealed by applying pressure after heating. And as shown in Fig. 4c, after the seal process by using said seal glass 100, the capping process of capping the ventilation opening 230 by using the seal glass for capping can be added.

In this way, the sealing process of flat panel display can be performed under a vacuum by using the seal glass of the present invention. Since gas or bubble is not generated during sealing process, desired vacuum and sealing state can be obtained. So it is possible to produce flat panel display without ventilation tube and ventilating step can be omitted.

Industrial Applicability

By using the seal glass of the present invention in sealing panels, sealing can be performed under a vacuum and, ventilating step is not necessary in producing flat panel display, and the production time can be reduced from about 10 hours to 20 minuites, greatly enhancing the productivity and throughput. Also, there is a advantage of producing flat panel display without ventilation tube.

Claims

What is claimed is:

1. A method for producing a seal glass which can be used in sealing under a vacuum, comprising:

step 1 which deposits frit in the form of powder or paste on both sides of a side glass and dries the side glass;

step 2 which removes binder and gas in the frit by applying heat to the dried side glass with frit deposited thereon under a vacuum in a vacuum chamber; and

step 3 which produces a seal glass by cooling the side glass from which binder and gas is removed.

2. The method for producing a seal glass of claim 1, wherein said step 1 comprises processing a side glass in the form of a seal glass by the process comprising:

cutting the glass in a predetermined shape according to the sealing specification of the object to be sealed,

depositing frit on both sides of the glass, and

drying the glass.

3. The method for producing a seal glass of claim 1, wherein said step 1 comprises preparing a side glass in a predetermined form by the process comprising:

depositing frit on both sides of glass bar whose width and thickness are determined according to the sealing specification of the object to be sealed,

drying and cutting the glass bars,

aligning the glass bars according to the sealing specification of the object to be sealed,

depositing frit on the surfaces to be connected, and

drying the glass bars.

4. A method for producing a seal glass which can be used in sealing under a vacuum, comprising:

step 1 which removes binder and gas by applying heat to the frit in the form of powder or paste in a melting pot or jig in the vacuum chamber, and

step 2 which molds the frit, which maintains fluidity after removing binder and glass, in the predetermined form of a seal glass.

5. The method for producing a seal glass of claim 4, wherein said step 2 comprises extruding frit which has fluidity, and molding a frit bar with predetermined diameter, so that sealing can be performed by cutting and aligning the molded frit bar so that connected regions overlap.

6. The method for producing a seal glass of claim 4, wherein said step 2 comprises molding the seal glass by pouring the frit which has fluidity into a mold prepared with predetermined shape.

7. A seal glass which is prepared according specification of the object to be sealed and can be used in sealing under a vacuum, produced by the process comprising the steps of:

depositing frit in the form of powder or paste on both sides of a side glass of predetermined shape and drying the side glass;

removing binder and gas in the frit by heat melting the frit under a vacuum in a vacuum chamber; and

producing a seal glass by cooling the side glass.

8. The seal glass of claim 7, wherein said seal glass is formed with frit of predetermined thickness deposited on both sides of the glass according to the specification of the object to be sealed, and is in the form of square frame.

9. The seal glass of claim 7, wherein said seal glass is a seal glass for capping which is formed with frit deposited on one side of the glass in order to block the ventilation opening.

10. A seal glass which can be used in sealing under a vacuum, wherein binder and gas are removed by melting under a vacuum, said seal glass molded in a predetermined form.

11. A flat panel display without ventilation tube, which is produced by sealing two panels while maintaining vacuum between the panels by the method comprising the steps of preparing a seal glass by heating frit in the form of powder or paste under a vacuum in order to remove binder and gas and molding in a predetermined shape, and sealing two panels using said frit in a vacuum chamber without extruded ventilation tube.

12. The flat panel display without ventilation tube of claim 11, wherein said seal glass is produced by the method comprising the steps of depositing frit on both sides of a side glass and drying the side glass which is prepared in a predetermined shape, removing binder and gas in the frit by applying heat in a vacuum chamber, and producing a seal glass by cooling under a vacuum.

13. The flat panel display without ventilation tube of claim 11 or 12, which further comprises a capping process after sealing using said seal glass, said capping process comprising capping the ventilation opening after injection of gas.

Fig. 1A

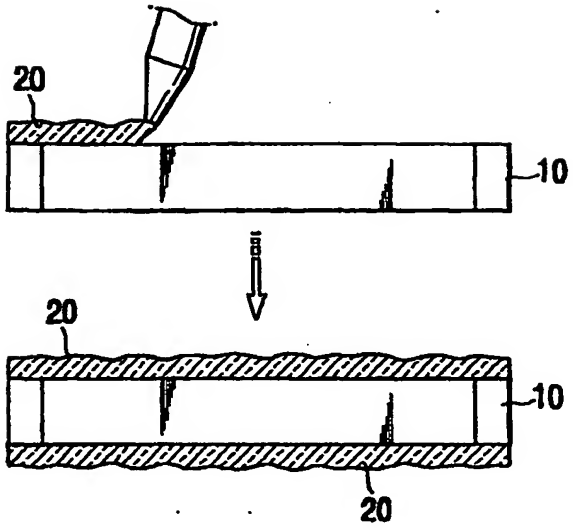


Fig. 1B

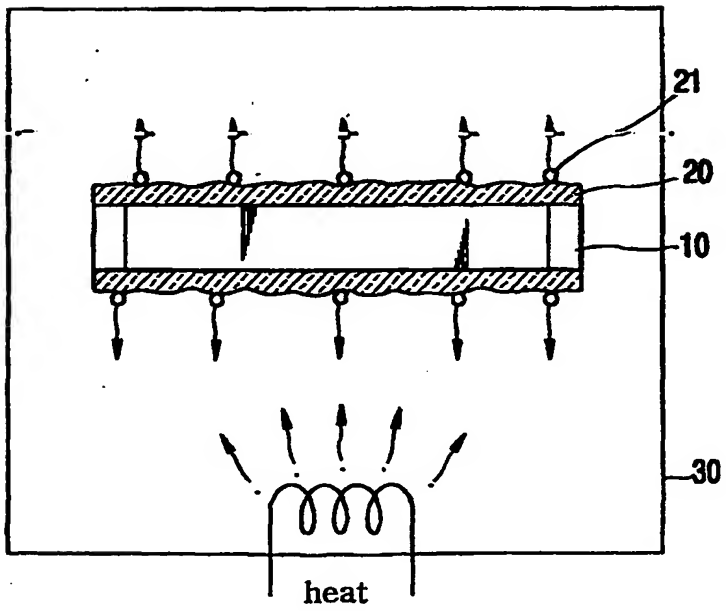


Fig. 1C

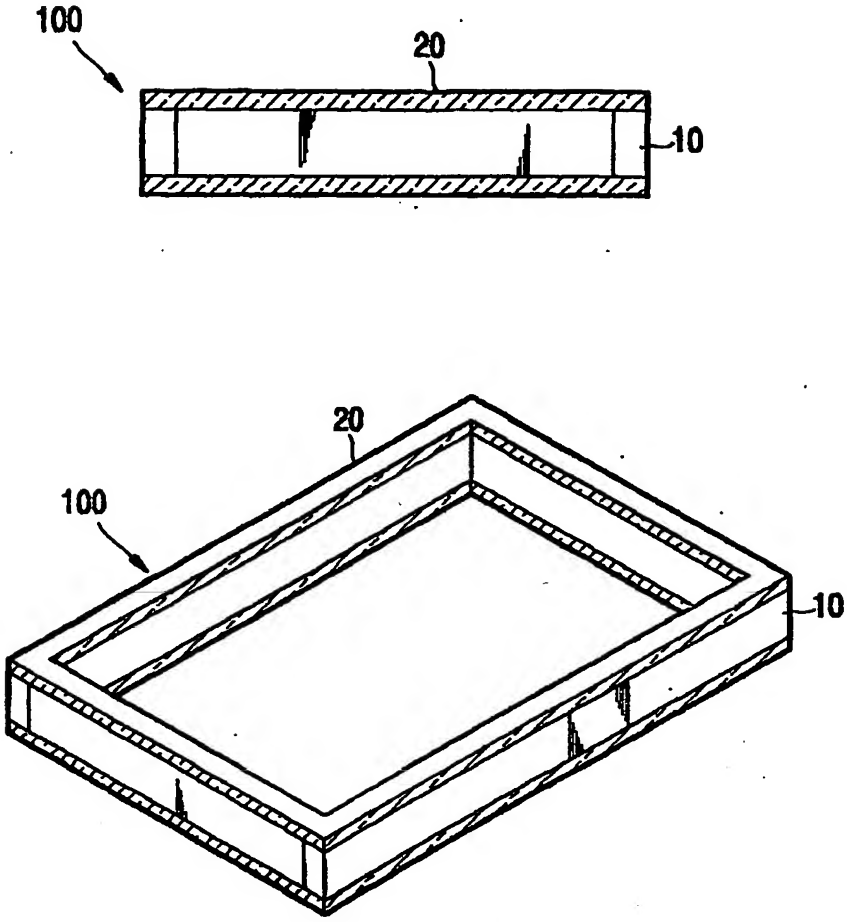


Fig. 2A

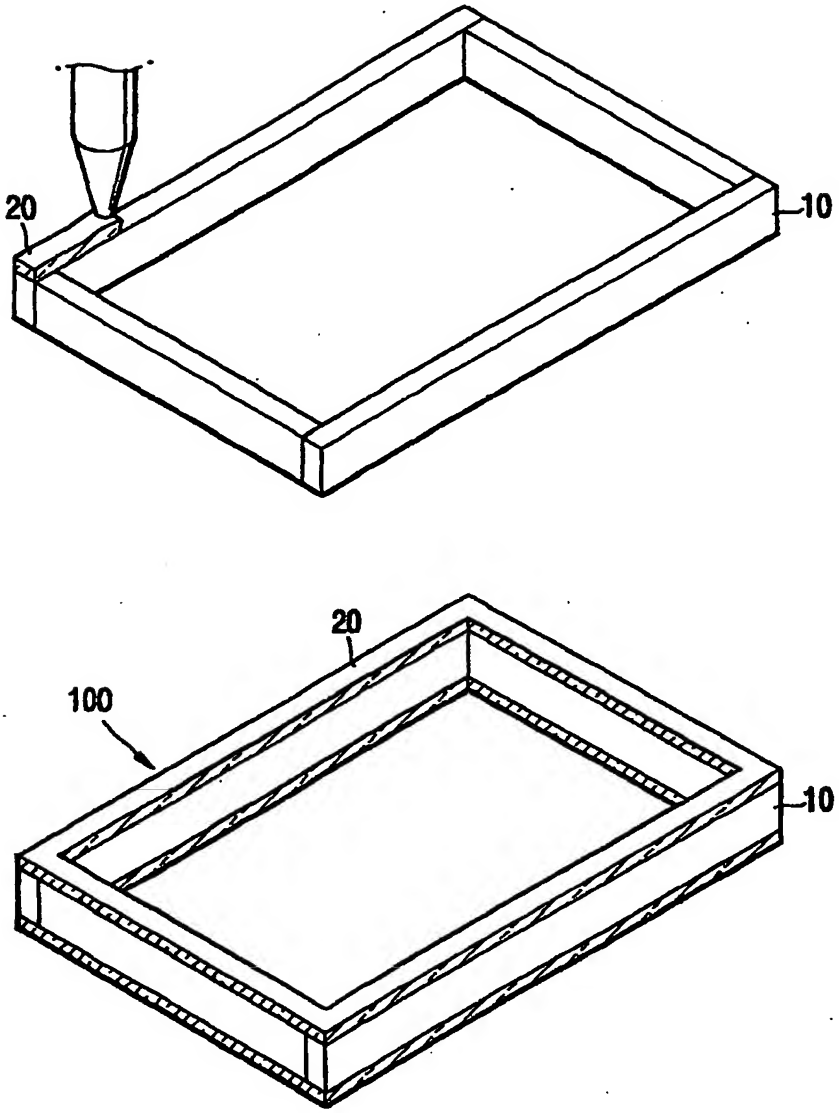


Fig. 2B

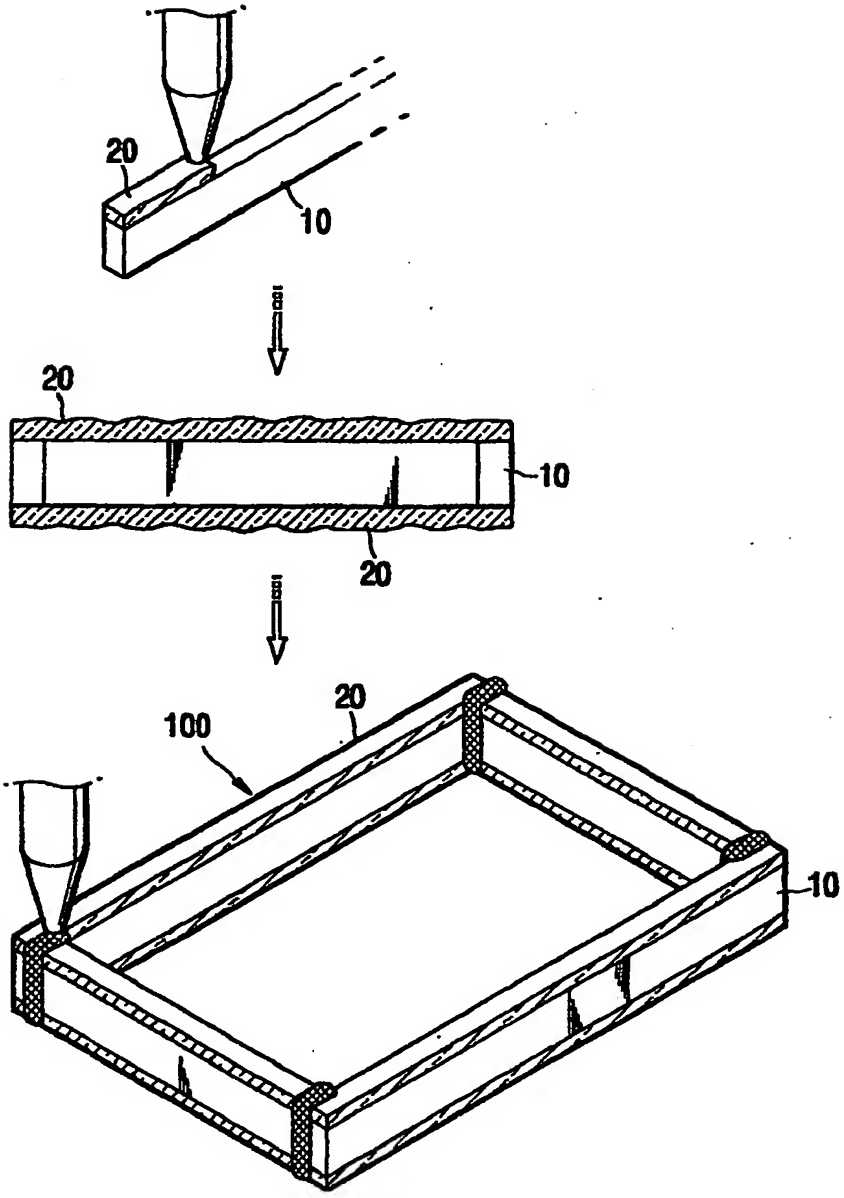


Fig. 2C

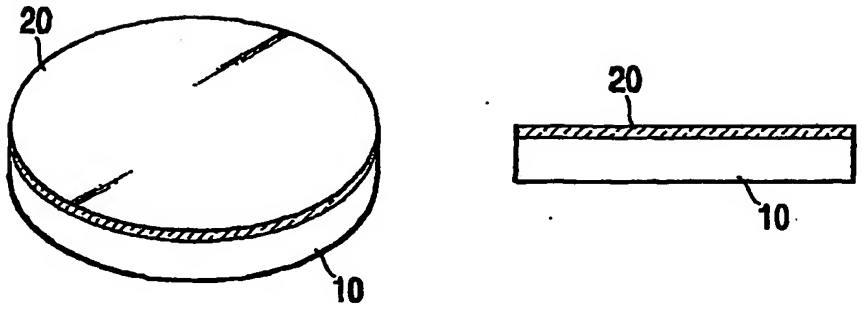


Fig. 3A

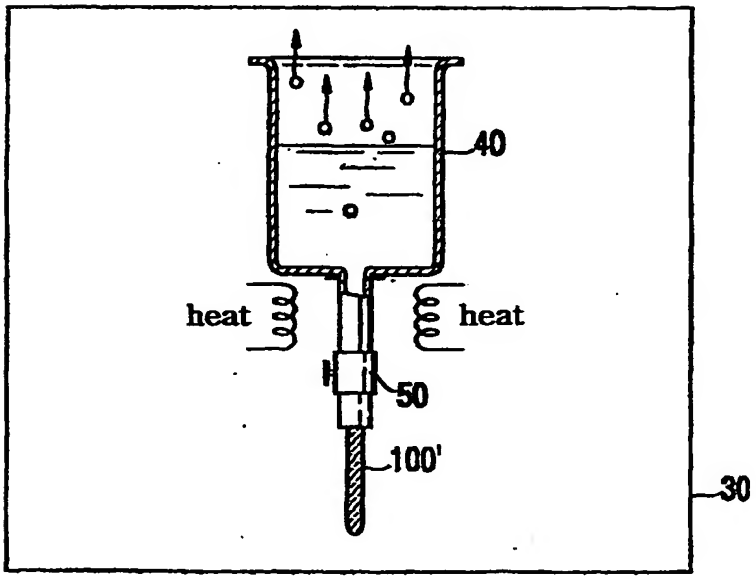


Fig. 3B

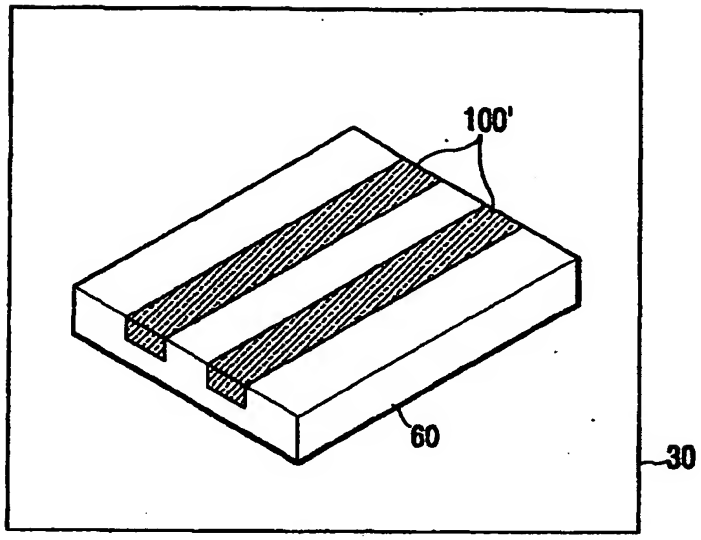


Fig. 4A

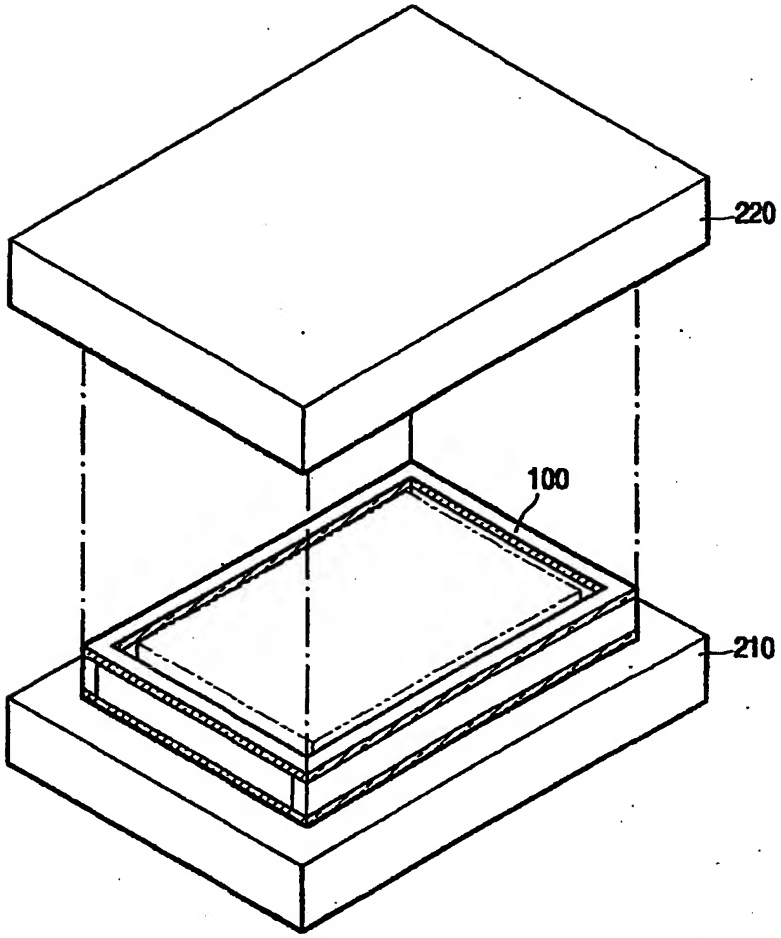


Fig. 4B

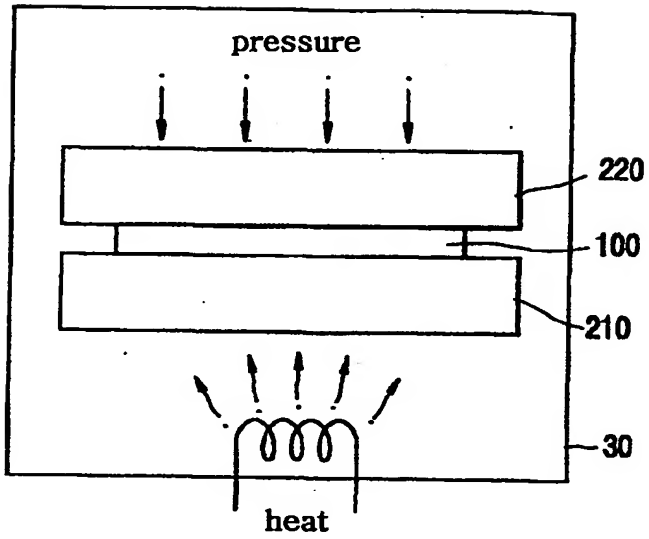
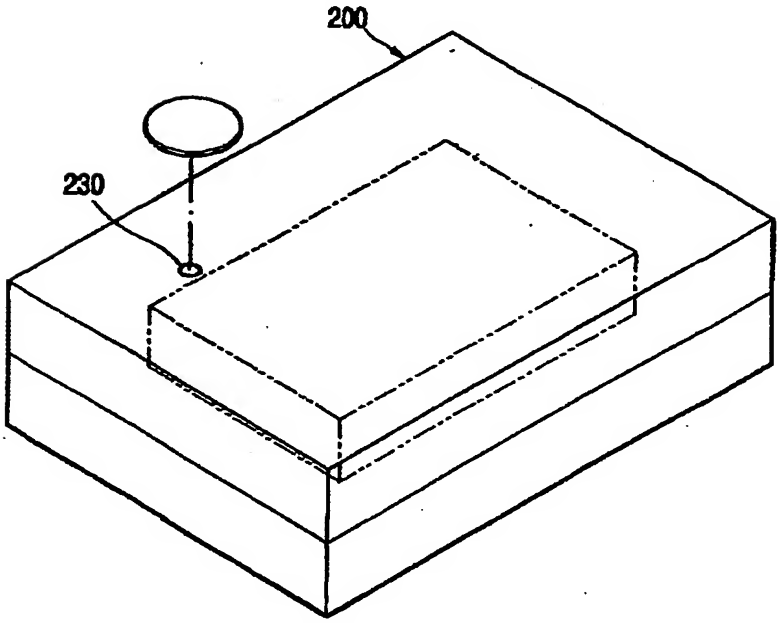


Fig. 4C



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR02/00244

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 H01J 17/18

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7 H01J 9, 17, 11

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean patents and applications for inventions since 1975
Korean utility models and applications for utility models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	KR 2001-8625 A (SAMSUNG SDI) 5 February 2001 lines 39 to 43, page 5-3; claim 6; Fig. 2	1 - 3, 7 - 9
Y		4 - 6, 10 - 13
Y	KR 2001-2393 A (LG) 15 January 2001 lines 2 to 22, page 4-3; claims 1 to 3, 5; Figs. 2, 3	1 - 3, 7 - 9
Y	JP 2000-57591 A (CANON) 25 February 2000 claims 1 to 3; paragraphs [0015], [0016]; Figs. 1, 2	1 - 3, 7 - 9
Y	JP 2000-277014 A (TORAY) 6 October 2000 claims 1 to 6; paragraphs [0049] to [0063]; Figs. 1, 2	4 - 6, 10 - 13
P, Y	JP 2001-206739 A (SONY) 31 July 2001 claims 1, 5, 7; paragraphs [0009] to [0015]; Figs. 1, 2, 4	4 - 6, 10 - 13
A	JP 8-138554 A (CANON) 31 May 1996 the whole document	1 - 13
A	JP 11-135041 A (TOSHIBA) 21 May 1999 the whole document	1 - 13

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevence

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevence; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevence; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 MAY 2002 (24.05.2002)	27 MAY 2002 (27.05.2002)

Name and mailing address of the ISA/KR	Authorized officer
Korean Intellectual Property Office 920 Dunsan-dong, Seo-gu, Daejeon 302-701, Republic of Korea	LEE, Doo Hee
Facsimile No. 82-42-472-7140	Telephone No. 82-42-481-5747

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR02/00244

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
KR 2001-8625 A	5. 2. 2001	None	
KR 2001-2393 A	15. 1. 2001	None	
JP 2000-57591 A	25. 2. 2000	None	
JP 2000-277014 A	6. 10. 2000	None	
JP 2001-206739 A	31. 7. 2001	None	
JP 8-138554 A	31. 5. 1996	None	
JP 11-135041 A	21. 5. 1999	None	